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The Indian Elephant

endangered in the land of Lord Ganesha

Ajay Desai

Series Editor, Bittu Sahgal
NCSTC-HORNBILL
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The Indian Elephant

endangered in the land of Lord Ganesha

Ajay Desai

This is an account of the life and times of elephants, which have been at the centre of the cultural and religious ethos of communities living on the Indian subcontinent for thousands of years.

The author, *Ajay Desai*, is a field biologist. He has spent long years studying and following the fortunes of elephants in India. While documenting the natural history of these magnificent animals, simply yet authoritatively, he makes a fervent plea for the protection of the gentle giants and their forest home.

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Series Editor, Bittu Sahgal
NCSTC-HORNBILL NATURAL HISTORY SERIES

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List of Plates and illustrations

The Indian elephant has been revered for eons. Far from being a drain on human societies, elephants have always helped to maintain and enhance the forests in which they live. They depend on water sources for their survival. But conversely, their habitats invariably help maintain the hydrological balance and thus enhance the water supply of downstream areas, including those used by humans.

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Editor's Note

The Bombay Natural History Society (BNHS) has been a fount of knowledge for over a century. It has created and nurtured thousands of naturalists from all walks of life. Today the Society continues to add to the body of information gathered by all-time greats such as R.W. Burton, E.P. Gee, J.B. S. Haldane and, of course, Dr. Salim Ali, the 'Grand Old Man of Ornithology.' Long before the subject of environment had become fashionable; before the word biodiversity had even been coined, the study of nature was a mission for hundreds of BNHS members. In time this enduring institution gave birth to an amazing network of amateur naturalists. Their prime joy, apart from tramping India's wilds, has always been to share their experiences, knowledge and information about nature with others.

It is in this context that the production of the NCSTC-HORNBILL series should be viewed. India is losing its natural wealth at a frightening pace and it is vital that decision-makers are exposed to the very real value of the ecological assets being lost to the nation. It is equally important that the rationale for wildlife conservation is understood. Humans, for instance, do not possess the technology to re-create the millions of hectares of natural forests, grasslands and wetlands we lose each year.

To maintain and to enhance the green mantle, which protects our soils and our water sources, we need the elephant to transport mango seeds. We also need chital to carry grasses from one part of the forest to the other as we do the tiny leaf warbler's non-toxic 'pest control' contribution. The cleaning service performed by turtles and crocodiles, frogs and the larvae of dragonflies helps make the water in our lakes and rivers drinkable. Every creature on Planet Earth performs a useful ecological role... save for *Homo sapiens.*

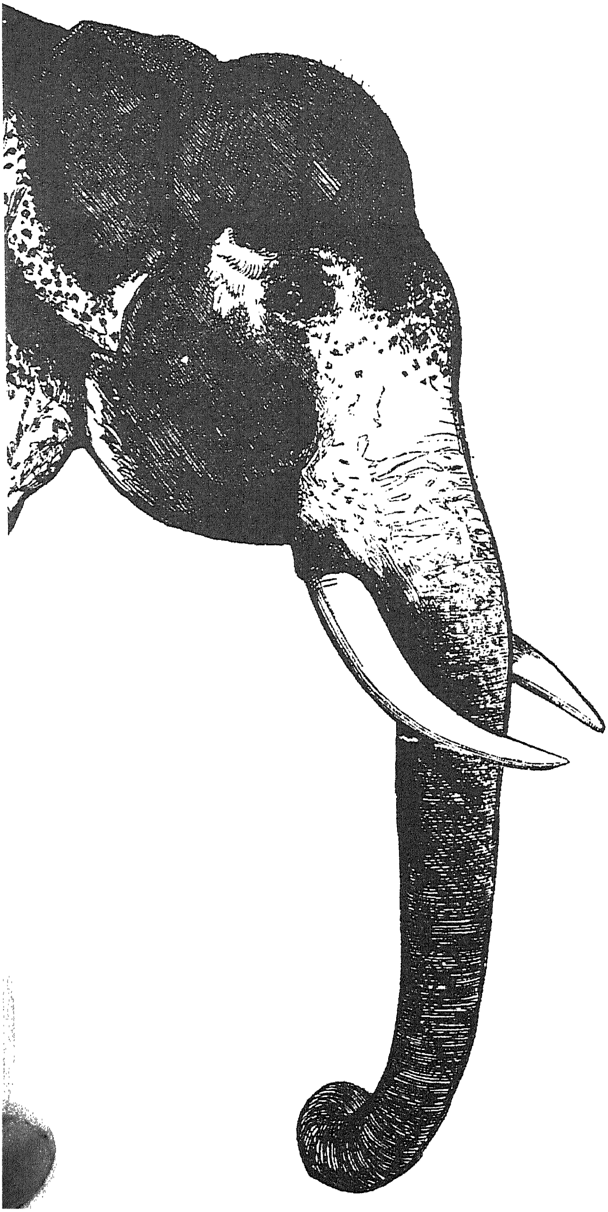
We probably started out right, but our capacity for abstract thought, our intellect and our relatively recent penchant for

consumerism, have lulled us into the mistaken belief that we can escape the consequences of the grevious damage we inflict on ecosystems and species. With each forest we lose, each river we degrade, each mangrove and coastline ecosystem we alter, the viability of the Indian subcontinent to sustain future Indians is diminished. Simultaneously the quality of life of perhaps over 100 million earth-people: among them, fisherfolk, forest dwellers, nomads and pastoralists... is lowered and their security compromised.

This latter aspect of the environmental and wildlife movements has only just begun to assert itself in our national psyche. Young people everywhere, social activists and human rights groups are fast recognising that protecting forests for the tiger, rhino and elephant automatically serves to protect both forest cultures and resources for communities which live outside the market system.

In the coming days this new partnership between naturalists and earth-people is destined to play a vital role in defending wild India. Towards this end individuals such as *Ajay Desai* have a crucial role to play as disseminators of scientific information. If the *NCSTC-Hornbill Natural History Series* manages to enhance the ecological information base of such initiatives and to replace pure sentimentalism with pragmatism in the battle to save nature... our purpose will have been admirably served.

Bittu Sahgal, Editor
NCSTC-Hornbill Natural History Series



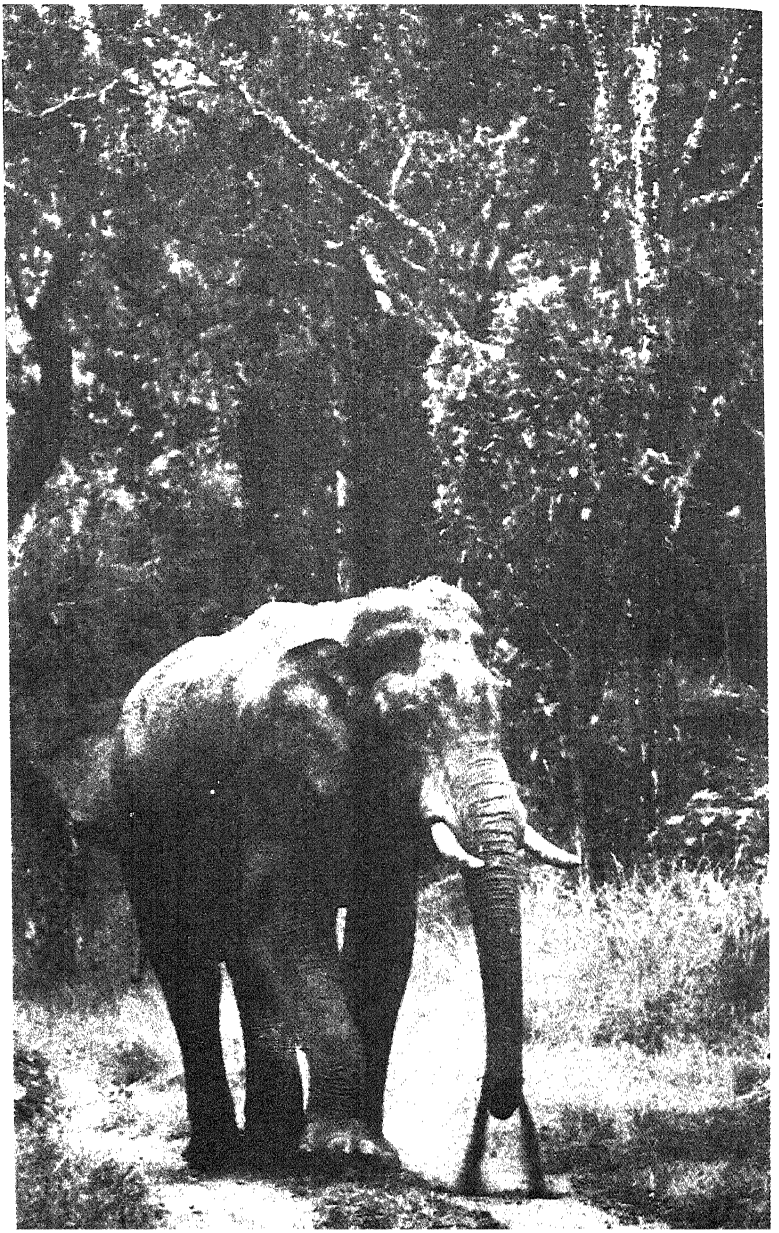
Publisher's Preface

This is one of a series of booklets that have been in the making for years! The wait has been worth it... both in terms of the contents and the fact that we have been able to win the involvement of the most authoritative authors on the various subjects chosen for the titles in the National Council for Science and Technology Communication, *NCSTC-HORNBILL Natural History Series.* NCSTC and the Bombay Natural History Society (BNHS) joined hands to bring the science of natural history to young people though adults too are sure to relate to the style and straightforward presentation. We intend to produce more titles each year to cover as wide a spectrum of nature as possible. We expect the publications to serve the dual purpose of disseminating information and keeping an archival record on the eve of the next millenium.

We wish to demystify the subject of ecology... to make it both understandable and acceptable to India's future decision-makers. The inter-relationships, the complex webs of existence, the contentious and confusing environmental issues... all these will need to be understood and grappled with by tomorrow's citizens. To the extent possible we have stayed away from scientific jargon for obvious reasons. We did not wish this initiative to be reduced to an isolated 'lesson' of the kind one often sees being taught in our schools and colleges.

In this book you will be introduced to elephants... how they relate to life in India, their ecological role in nature and the severe threats that loom large over their future. *Ajay Desai* has attempted to present the elephant within the larger context of the ecology of the subcontinent. We trust that this (and the other titles in the series) will encourage readers to search for the larger picture, the totality of inter-relationships... and thus better understand our own role on this planet.

Dr. Narender Sehgal, Series Publisher,
Director Vigyan Prasar, June 5, 1997



Author's Acknowledgements

I worked as a scientist on the Bombay Natural History Society's Elephant Project for 11 years and in this period numerous people have helped me in various ways. I am indebted to them all.

To begin with, the U.S. Fish and Wildlife Service funded our project for nine long years. The Salim Ali Centre for Ornithology and Natural History (SACON) and the Ministry of Environment and Forests also funded the project, though for shorter durations. The Forest Department of Tamil Nadu helped with logistic support as did the Forest Departments of most elephant-states.

Mr. J.C. Daniel encouraged me and furthered my work throughout the study. I owe special gratitude to my trackers: Bomma, Channa, Krishna, Kattan, "Kardi" Madha and to my drivers: Siril, Subramani and Gopal with whom I shared so many field experiences in the company of elephants. Krupakar, Senani, Connie, Anju, Shanthini, Nima, Justus, Wesley and Mihir... I thank you all. Gautam, Lima, Ravi, Hemant, Issac... your friendship and company has been invaluable. I enjoyed the company of and help from Baskaran, Balasubramanian and Swaminathan. Doc (Dr. Krishnamurthy) and Chris shared fun and information. Dr. A.J.T. Johnsingh has always stood by me and was a source of inspiration. My aunt "Babakka" (Mrs. P. Goankar) and cousin Prathiba have always been excellent hosts during my numerous trips to Mumbai.

Finally I wish to acknowledge my family without whom I wouldn't be where I am today. They have stood by me through thick and thin. To my mother, my brothers, Ashok and Arvind, my wife Shanti and my children Aaron and Swapneel, I express my deepest thanks... not by far enough for the lifetime of love and support I have received from them.

Aaron and Bundle, here's your "Andinde" book.

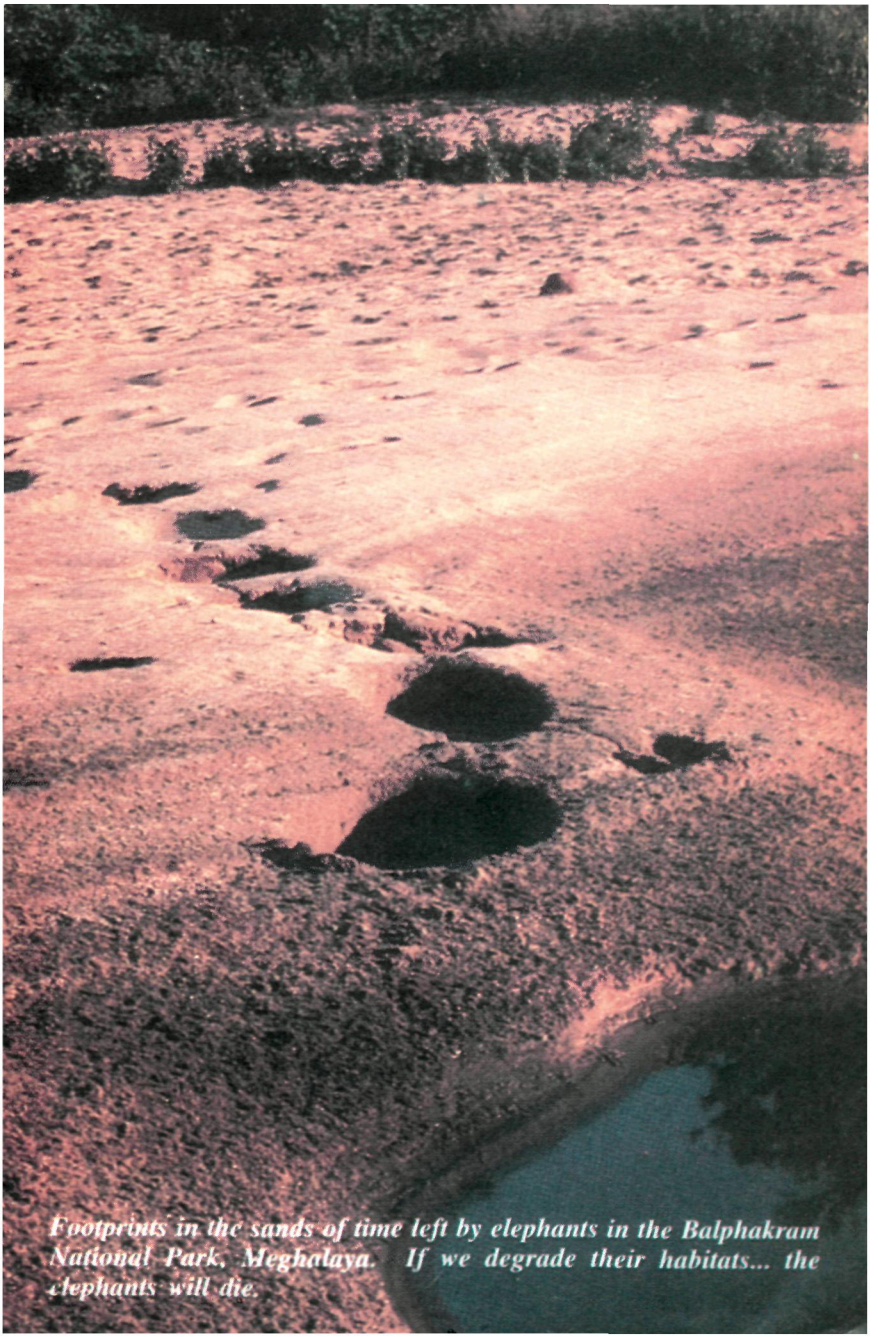
Ajay Desai, Field Biologist, June 5, 1997

Into elephant country

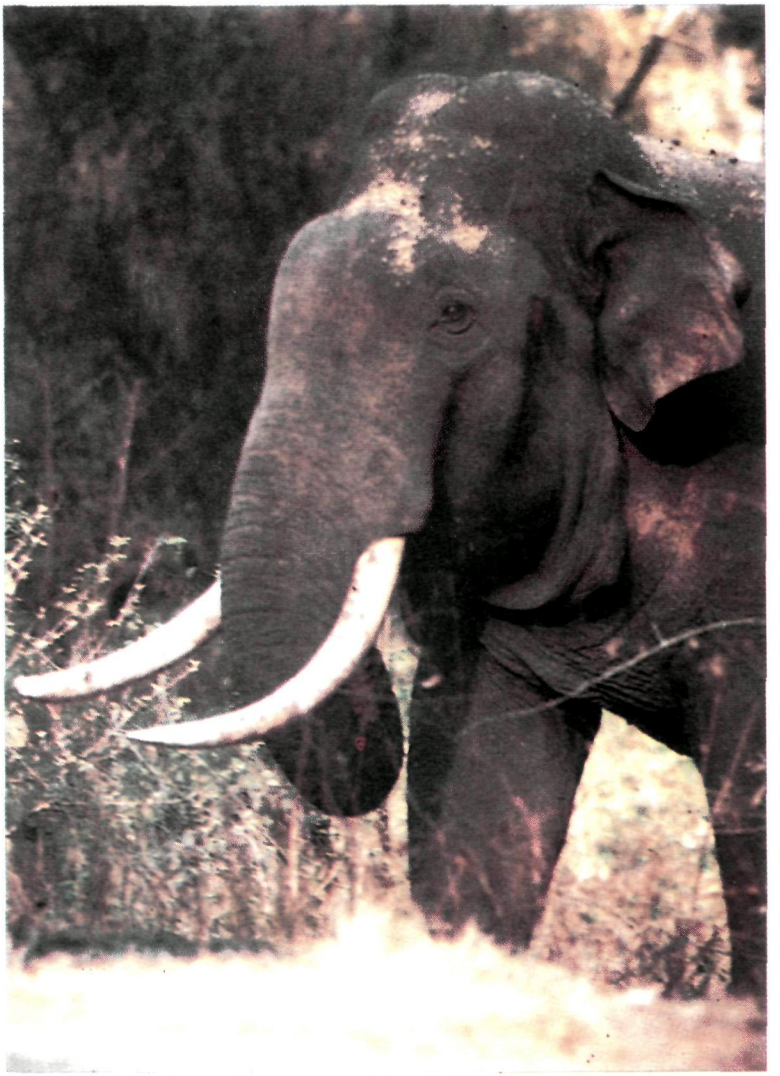
We had been walking all morning and by two o'clock in the afternoon the sun was decidedly hot and unpleasant. Having covered over 15 kms. of harsh but beautiful terrain, Channa (my tracker) and I were tired and the cool shade of the *nullah* looked especially inviting.

I hurried forward and entered the rather deep *nullah* ahead of Channa so that I'd get the best spot to lie down. As I passed a small bamboo clump, I pushed aside a thin stem and let it swing back after I had crossed. Suddenly I felt something hit my hand. Notebook, pen and binoculars, all flew out of my hand as the thought flashed through me: "I've been shot!" This was not such impossibility in remote elephant-inhabited areas that are, often as not, frequented by poachers who are unfazed by death – animal or human. In an instant, I thought back to the time when friends in the Karnataka Forest Department had come close to taking a shot at me, mistaking me for an elephant poacher escaping into Tamil Nadu. Fortunately, the Director of Bandipur Tiger Reserve recognized me then (he was using the binoculars). As it turns out, I was not the target of a bullet this time either. There was no blood on my hand, but it certainly felt like it was on fire. Something had bitten me! With a wry smile Channa pointed out a wasps' nest to me. Not that he needed to show it to me, I had already put two and two together. I was used to quick thinking, as it was a survival art in the forest.

The wasp bite hurt, my empty stomach ached and the merciless summer sun bore down on us with all its fury. We had to walk at least another 10 kms. before we could get food or water. It's a tough life in the jungle. For the hundredth time I asked myself what I was doing there. And the answer came: "Elephants!" That's it. That one word seemed to justify everything.



Footprints in the sands of time left by elephants in the Balphakram National Park, Meghalaya. If we degrade their habitats... the elephants will die.



A large male elephant in musth, *a condition which involves a sharp increase of testosterone levels in the blood. Testosterone increases sperm production, sexual drive and aggression, all of which are favourable for successful reproduction.*

Elephants fascinate me. I have lived with them and studied them for over 11 years, yet they continue to amaze me. I'm not alone. Elephants have fascinated mankind perhaps more than any other species of animals on earth. Stone-age cave paintings show people hunting elephants and today almost everyone on earth knows at least something about elephants. In the East, elephants have become an inseparable part of our life and culture. This is especially true of India where elephants are an integral part of our everyday lives.

Ganesha, the elephant-headed son of *Shiva* and *Parvati*, one of the principal Hindu deities, is worshipped as the God of Wisdom and Remover of Obstacles. The festival of *Ganesha* is a particularly happy time for children, when homes are decorated with lights and sweets are distributed. Finally – big and small, painted and bejewelled idols of the elephant-headed *Ganesha* are taken in procession for immersion.

The earliest known domestication of elephants dates back to the Indus Valley Civilization over 4,000 years ago. However there is a possibility that they were being tamed even earlier in southern India and Southeast Asia. In the industrial West, the elephant has universal appeal though it was never ingrained in their culture or lives.

Despite the long and close association man has had with the elephant, most people know little or nothing, however, about its natural way of life in the wild. And fewer still know that desperate last-ditch battles are being fought to save this wonderful animal and its habitat from potential extinction. This is not to say that nothing has been gleaned of its behaviour. Over the years, bits and pieces of its life have indeed been put together. But the picture that emerged was more in line with the story of the six blind men. Each touched a different part of the elephant and tried to describe

what it was like. One touched the flank and claimed that it was a wall. The second touched the ear and said it was a fan. The third claimed it was a tree after touching its leg. The fourth thought it was a snake, after touching its trunk. The fifth said it was a spear after feeling its tusk and the sixth stated that the elephant was in fact rope after touching its tail. We have a lot to learn about wild elephants, but I would like to share here some of the information I have collected so that pieces can be filled in the jig-saw of its life story.!

The very beginning

"Elephants have fascinated man, perhaps more than any other animals."

Present-day elephants evolved over a period of 50 million years from small pig-like ancestors known as *Moeritherium*. This is not all that surprising when you consider the fact that the tiny hyrax, is a close living relative of the modern elephant. From the basic features of the *Moeritherium* evolved the Order *Proboscidea* (trunked and tusked animals) to which elephants belong. Many families evolved and became extinct over this period of time. They included *Gomphotherium*, *Platybelodon*, *Ambelodon* and *Deinotherium*, which differed in size, structure and tusks.

The family *Elephantidae* to which the African *Loxodonta africana* and Asian elephants *Elephas maximus*, belong evolved around five million years ago. Several species evolved and became extinct in the evolutionary line leading to the Asian elephant. One of those that became extinct was the dwarf elephant *E.falconeri*, just one metre tall at the shoulder. It lived on the Mediterranean Islands.

The largest of all elephants and one of the earliest known

mammoths was *Elephas trigontherii*, it was 4.5m. tall at shoulder. Watching a herd of these giants must have been a truly magnificent sight. Of all the extinct early elephants, people are most familiar with the Woolly Mammoth. It was almost the same size as the Asian elephant (3m. tall at shoulder) but covered with thick long dark hair. It had five-metre-long spiralling tusks. Mammoths probably used these huge tusks to clear the snow off the ground so that the fodder underneath became accessible. In all extinct elephant species the tusks were essentially used for assisting in feeding.

"Ganesha is worshipped as the God of Wisdom and the Remover of Obstacles."

Woolly mammoths have been widely illustrated in Stone Age cave paintings over 20,000 years ago. Carcasses, some of them nearly intact, have been found in Siberia. Sizeable quantities of tusks and skeletons have also been unearthed in these frozen regions. All these findings have made the woolly mammoths among the best-known extinct elephants! The thick hair and a layer of fat allowed these creatures to survive in the extreme cold of the Ice Age. But they were unable to survive hunting pressure by man and became extinct 10,000 years ago.

Though tusks are automatically associated with elephants, other dissimilar animals also sport them. Tusks are actually enlarged incisors composed of dentine. The cap of enamel over the dentine wears off. Usually one-third of the tusk lies within and is deeply embedded in the skull. The root end of the tusk is hollow and filled with vascular tissue, which extends forward into the tusk to a point just beyond the lip line. Calves have milk tusks, which fall off after the first year.

What really sets elephants apart from other animals is the

distinctive trunk. This vital tool is a combination of nose and upper lip and forms an elongated mobile organ that also functions as a 'hand'. The elephant makes varied use of its trunk, though its hand function is all-important as the elephant would be unable to feed without it. It is also used in drinking, bathing (water, mud and dust baths), communication (sound), to dig holes in dry riverbeds to reach sub-surface water and as an awesome weapon of self-defence. Exceedingly sensitive, the trunk functions as a tactile sense organ as well.

Yesterday and today

The Asian elephants were once widely distributed throughout southern Asia. They were found as far west as Syria. The Egyptian Pharaohs used to hunt both the African elephant and the Asian elephants. Hunting, capture and the spread of human settlements led to their extinction in Syria. This trend continues and today the western-most distribution of Asian elephants is in Uttar Pradesh (the Rajaji and Corbett National Parks) in India. In the East they are found up to Indo-China. But their range has shrunk to a fraction of its original size and most of what is left is fragmented.

"What really sets elephants apart from other animals is the distinctive trunk."

In India they were once found throughout the subcontinent, including the present-day Gujarat, Rajasthan, Punjab, Madhya Pradesh and Andhra Pradesh. It is difficult to even imagine elephants in States like Gujarat and Rajasthan, but the fact is that they did roam these States in the not too distant past. Even as late as the last century they were found in Punjab, Madhya Pradesh and Andhra Pradesh. Today they are locally extinct in all these states. In recent years stray herds have wandered into Madhya Pradesh and Andhra Pradesh from neighbouring states, but these

are just problem herds which have left their normal ranges and wandered off in search of survival in better habitats than the ones from which they were driven by hungers.

What was it that led to this drastic decline in the distribution of the Asian elephant? The answer is simple: What happened in Syria happened everywhere. Hunting for ivory and sport and capture for domestication for work and war depleted elephant populations. Their range and numbers were further diminished when expanding human settlements and agriculture ate into their wild home. Inevitably, elephants were gradually exterminated from these newly settled areas. Kautilya in his manual on statecraft, *Arthashastra* (c.300 BC to 300 AD), states unequivocally that elephants should be eliminated from river valleys with human settlements.

"Jehangir, the Moghul Emperor had 12,000 war elephants in his army."

Elephants have been killed in large numbers for sport, ivory or just to eliminate them from the proximity of agricultural settlements. Bounties were paid for killing them around agricultural areas and thousands were shot dead to protect crops. Still more were captured and enslaved. The level of demand can be gauged by the fact that elephants were even imported from Sri Lanka into India. Jehangir, the Moghul Emperor was reputed to have had 12,000 war elephants in his army and 40,000 elephants in his whole empire. That is about the total number of wild elephants left alive in all of Asia. The Khmer rulers outdid Jehangir. By some accounts they had a stable full of an incredible 200,000 elephants!

Killing and capture on such a massive scale reduced elephant numbers. And the growing human population with its demand for more agricultural land only further encroached on elephant

habitats. These two factors have reduced the once widely distributed and abundant species to its present status as an endangered species. Today habitat loss continues to be a major threat to the few remaining elephant ranges.

Where can you see the Indian elephant?

Four separate elephant populations have been identified: The southern population in Karnataka, Tamil Nadu and Kerala (some straying from Karnataka and Tamil Nadu into Andhra Pradesh). The northern population, which is restricted to Uttar Pradesh (mainly Rajaji and Corbett). The central population is mainly centered in Orissa, with a few animals in Bihar. And the eastern population is to be found largely in Meghalaya, Assam and Arunachal Pradesh. Smaller numbers are, of course, found in West Bengal and in the other Northeastern states.

"Killing, capture and usurpation of elephant lands has harmed their interest"

In South India it is possible to see elephants in the thorn forests at the foothills of the Western Ghats. Here they are fine-tuned to survival in a harsh environment where food, water and shade are all at a premium. The extensive dry and moist deciduous forests of the Western Ghats support large elephant populations. This is probably their most secure home, though here too there are problems galore. Dry season fires, for instance, play havoc in the ecosystem causing elephants to face a resource crunch till the rains arrive. Controlled early burning coupled with better fire control measures could definitely make the situation better for elephants. Elephants make use of similar habitats in the Eastern Ghats, though they are not as abundant as they are in the Western Ghats. Here their range has become highly fragmented and they face a bleak future. Perhaps the finest elephant sightings are available in the Nilgiri

Biosphere Reserve and the Periyar Tiger Reserve. In Central India elephants occupy sal forests and the Simlipal and Palamau Tiger Reserves are among the better places to observe the pachyderms. In north India too elephants can be seen in the sal glades of the Corbett Tiger Reserve. The Central and North Indian populations live in habitats similar to, but more hilly than, the deciduous forests of South India. Everywhere, fragmentation, degradation and poaching threats looms large.

Almost nothing can prepare you for the experience of watching elephants in the grasslands of Manas and Kaziranga. Here entire herds can disappear in moments, swallowed by tall elephant grass. The evergreen forests of South and Northeast India offer the least visibility to those in search of elephant sightings. Getting even a fleeting glimpse is often just a matter of luck. Elephants exist at low densities in evergreen forests as most of the plant biomass is tied up in huge trees inaccessible to elephants. The Northeast Indian elephant population faces a multitude of problems. To deforestation, fragmentation and degradation, is added insurgency and conflict with local human populations. In the crossfire between habitat destruction and poaching a question mark hangs over their future. Sanctuaries and national parks can certainly provide welcome space for elephants to find a temporary reprieve from extinction, but what they really need is protection on the outside.

"Everywhere fragmentation, degradation and the threat of poaching looms large."

The family life of elephants

Elephants live in a matriarchal society where the oldest female is the leader. The earlier belief about herds being led and defended by the "herd bull" is little more than an old wife's (read *shikari*)

tale. Males leave their natal families after attaining puberty and then lead more or less solitary lives. They form transient associations with other males or with herds of females they may chance upon. Without a doubt, the matriarchal society is the key to the survival of elephants.

Elephant populations are composed of several clans and solitary males. Clans are groups of elephants (adult females and their offspring) which may be related to each other. Members of a clan will mingle and form associations with others in the clan. Different clans or members of different clans, however, do not associate with each other. Though association between clans has been recorded in Africa, I have never observed this personally in a whole decade of study in the Nilgiri Biosphere Reserve. The clans I studied invariably avoided each other.

"The birth of a siblng helps prepare the female calf to play the role of allomother."

Clans basically represent large extended families but it should be pointed out that within the clan all members do not associate with each other equally. Some develop special affinities and can be seen associating with each other more frequently than with other members of their clan. We define these as bond groups that are actually made up of several family units with a special bond between them. These family units comprising adult females and their dependent offspring are seldom seen apart from each other. Elephant calves are prepared for their role in elephant society at an early age. Differences between the outlook of male and female calves become very evident with the arrival of a sibling. The intercalving interval in good habitats, where food is aplenty and herds feel secure, is about four to five years. Very rarely does the mother allow the older calf to suckle after the birth of the new calf.

To the female calf the birth of a sibling is a momentous occasion. She adjusts to the weaning quickly and generally becomes helpful within the family, preparing to play the role of an allomother. This behaviour has a purpose as it helps the young female to develop the traits required to be a successful mother in later life. The mother also benefits, as she gets more time to devote to her own well being since the older sibling is looking after the newest arrival. At times adult females who do not have calves of their own will act as allomothers, but this is not common. By and large subadult females play the role of allomother. Studies in Africa reveal that calves survive better when they have allomothers around. Clearly this behaviour is vital to elephant societies.

"For the male a new sibling means competition. He will not take well to weaning."

Female calves continue to live and grow in their natal bond group till they become adults and have family units of their own. They may in fact spend their entire lives in such a group. Ecological stress may sometimes lead to competition for resources between the young adult female and her mother or with other bond group members and this could force her to leave the bond group. Such an animal will obviously try and form her own bond group or join another one, but she will first do everything possible to avoid being disconnected from her original companions.

Unlike females, male calves look upon the arrival of a sibling as competition. And why should they not? After all they almost instantly lose access to their mother's milk. They do not take to weaning with any dignity and often the mother has to use force to weaning them away. Once weaned, males take absolutely no interest in their sibling and what is more they contribute nothing to the family. They still enjoy the protection of the herd, however,

even as they begin to associate and play more with other males, especially those that have also been weaned.

Weaning understandably leads to diminished dependence on the mother and this in turn is the signal to start moving about with other bond groups within the clan. All the while close links are still retained with the natal bond group. At this point in their lives they are still too defenceless to be independent and are vulnerable to predation. They therefore continue to stay with their natal bond group. Tigers would conceivably be able to take unprotected elephant calves at this point in their lives. By the time males reach the age of nine or ten they are already too big for any tiger. Around now they are able to free themselves of the dependency of the bond group or clan.

"Dispersal prevents males from coming in contact with close female relatives."

The young adult male also competes with the adult females and their dependents for food. In any event his energy requirements are much greater than that of a female his age. My studies have shown that juvenile and sub-adult class males spend more time feeding and playing than do females of the same class. Unable to dominate adult females at this stage, the male drifts further and further to avoid competition. He is gradually breaking away from the herd and is now on the way to total independence. Perceiving clan members to be competitors he loses all basis for following the clan on their seasonal and local migrations. I first recorded males becoming independent of their clan when they were in the age group of nine to 13, with the male staying behind when the clan moved on. Nevertheless, not all contact with the clan was broken at this point as young males continue to return to the clan often. By the age of 15 male association with the natal clan is irregular at best.

This separation actually brings them in contact with a larger segment of the local elephant population. This would not have happened if they had remained in their natal clan. By temporarily associating with new clans and following them, the males get to explore areas outside their natal home range. Gradually, this helps them establish a new home range of their own which may partly overlap or lie totally outside their natal home range. By the time they are 20 to 25 years of age they will have formed their own new home range. This will expand as they grow older and come into *musth* regularly.

"Juvenile males spend more time feeding and playing than females."

Finding a new home

The process of moving out of the natal home range and forming a new home range is called dispersal. This phenomenon is important to elephant populations. Although the main cause for dispersal is admittedly the competition for resources, the real benefit is avoidance of inbreeding. Dispersal prevents males from coming into contact with close female relatives.

Dispersal also helps maintain genetic variability in elephant populations. This is one of the reasons that secure land corridors between sub-populations of elephants are so vital. Small sub-populations that are cut off from other populations tend to lose their genetic variability as no new genetic material can be infused. What is worse, inbreeding also takes place as males, which are prevented from dispersing, begin to mate with related females.

Dispersing males will test their strength through play fighting. New dominance hierarchies are thus established without the risk of serious injury. Play behaviour, primarily play fighting, is

important to the development of the male social organisation. The new hierarchies help avoid serious conflict when there is competition for resources. In fact, only when they compete for an oestrous female, do males take their fighting seriously. This is likely to occur when two males of similar size, or males in *musth*, compete.

After they become independent males live largely solitary lives, forming temporary associations with other males and clans that they encounter in their range. Their association with females is mainly for breeding. Males and females differ in their requirements for resources. Their large body size — 25 to 50 per cent larger than the female — their solitary nature and the advantage of having no dependents, allows males to survive successfully even in poor habitats. Their requirement of food, water and shelter is less than those of an average female herd of say eight. They are also able to tolerate greater stress than females and calves.

"After they become independent, males will live largely solitary lives."

Calves are particularly sensitive to adverse conditions and ecological stress (heat, food or water shortage) leads to higher calf mortality. For the females, reproductive success means the successful raising of calves. So females have to select areas that are suitable to calves, even though on their own they would be able to survive in poorer habitat conditions. Thus, females must be more discriminating in their selection of home ranges. This is fundamental to the success of elephant societies.

In nature the wheel of fortune keeps turning. The availability of feeding grounds, for instance, varies over the year with seasonal change. Similarly, over the years, climatic changes will affect habitats and thus the ecological security of herds.

Long-lived animals like elephants must learn to cope with variation in habitat quality and the availability and distribution of key resources. To be successful, females must therefore acquire an intimate knowledge of the resources available to them within their home ranges... in good and bad seasons. This knowledge can be acquired only through years of learning and it is passed down from older to younger animals in the clan. This is one very specific advantage to females that stay on with the matriarch and the clan.

As the learning process continues they will also breed and, again, the knowledge of the matriarch comes to the fore in ensuring that new arrivals are given an extra edge on survival through group defence. Thus, the choice to stay with the clan benefits not just the individual, but another generation. As survival strategies are passed down from generation to generation the role of the matriarch as a storehouse of information becomes plainly obvious. Any female choosing to break away on her own would be exposed to a trial-and-error process to ensure her breeding success and this, clearly, is not her best option.

"The availability of feeding grounds varies over the years with seasonal change."

Musth and the art of good good breeding

The male social organization is geared primarily towards a strategy for reproductive success. Their larger energy requirement forces them to leave family groups earlier than females. Their large body size allows them to withstand adverse conditions and thus to explore and exploit new areas at comparatively lower risk. By establishing home ranges away from clan they avoid inbreeding by the time they are ready to have offspring of their own. Males become sexually mature early... records suggest this

can be as young as 10 or 12 years. But this does not suggest they will be able to mate successfully in the wild. For this they must wait till they are much older. In a population with a normal male to female ratio (no poaching) it is unlikely that males below 25 years will ever get a chance to mate. Older bulls will prevent this as they will assert their hierarchical status.

Perhaps the most fascinating aspect of adult male elephant behaviour is the phenomenon of *musth*, a condition in which the male elephant exhibits noticeable physical, physiological and behavioural changes. At this time, externally, the male's temporal glands, which lie between the eyes and ears, swell up and secrete a fluid. He will no longer unsheathes his penis to urinate; instead urine will keep dribbling leaving both his penis and his hind legs urine, almost constantly wet. Both the temporal gland fluid and the urine have a strong, pungent smell. In the field whenever I have come across the trail of a *musth* male, it was always the smell that first caught my attention. But these are only the external manifestations of the changes. The sharply increased levels of testosterone in his blood govern the real transformation during *musth*. Testosterone increases sperm production, sexual drive and aggression, all of which are favourable for successful reproduction. There has been some debate about whether or not *musth* is related to mating. My studies, however, show that reproduction is its only function.

"Musth is the most fascinating aspect of adult male elephant behaviour."

The physiological changes in the body induce a change in the behaviour of the elephant. The increase in sexual drive results in his wandering over larger areas in search of females. Home range sizes during *musth* are greater than normal. Males will also eat less during *musth*... basically because the food imperative must

compete with another powerful urge. *Musth* males associate more with female herds than non-*musth* males. Though most matings are by *musth* males, this does not mean that non-*musth* males cannot mate successfully. But such success is rare.

The condition makes males more aggressive and conflicts over oestrous females are all too often between *musth* males. I should make it clear that aggression does not mean that the huge animals go about spoiling for a fight. Rather it suggests heightened confidence and a preparedness to commit him to combat if challenged. Ironically, because m*usth* males often ignore the presence of humans, some mistakenly interpret this as a sign of non-aggressiveness!

"Musth males associate more with female herds than non-musth males."

While in *musth* a captive elephant is more likely to strike out at his human masters, especially if the *mahawat* is one that ill-treats his animal. This is because the 'normal' submissiveness gives way to dominance over the one who threatens him. In such a situation the elephant reacts in the only way it knows... combat. Unfortunately for the *mahawat* it is an extremely lopsided encounter. Elephants in this state have been known to go on the rampage killing or maiming any and everyone it encounters, perceiving all humans as a threat to its dominance.

The swelling of the temporal gland, the amount of gland fluid that flows out and the dribbling of urine are all related to the age and size of the elephant. Males come into *musth* between the ages of 15 to 20 years. But at this stage they have neither the temporal gland swelling nor the phenomenon of dribbling urine. They do however secrete some fluid from the temporal gland, but the process lasts no longer than a week. Males in this size category

rarely get to mate, as they cannot compete with the older males. They will however try to sneak a mating opportunity when an older male is distracted, but the chances are the female will reject his armorous advances preferring to accept genetic material from a more powerful, older male.

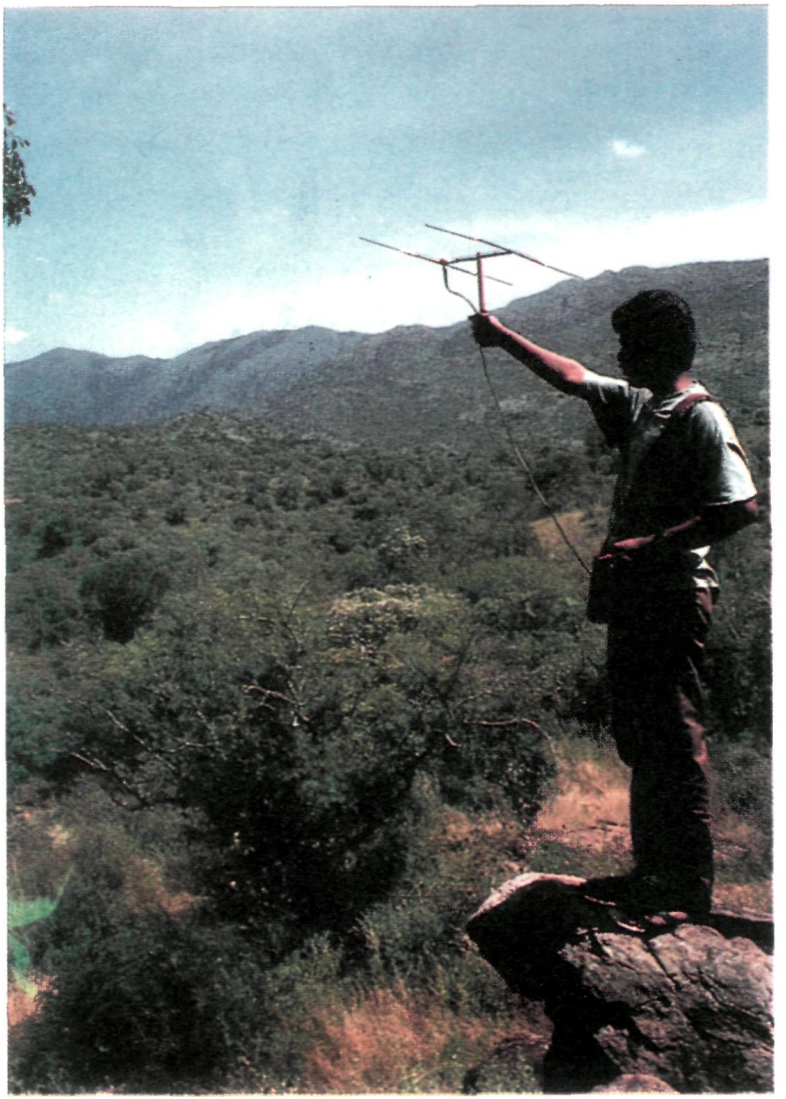
The intensity and the duration of *musth* increase till the animal is between 25 and 30 years old. Now clear signs of temporal swelling are visible along with a good flow of temporal gland fluid. The dribbling of urine also begins and the animal could well stay in the *musth* state for four to six weeks. Males in this age category usually come into *musth* when older males are not in *musth*. This gives them a more competitive edge on access to females. A slightly smaller male in *musth* could possibly dominate a marginally larger non-*musth* male.

"A smaller male in* musth *could dominate a larger non-*musth *male."

Once males reach the age of 40 they are in a different class altogether. Their body bulk now really builds up and the quantum of fluid flowing from the temporal gland is huge. The classic smell of urine and *musth* hangs heavy in the air. Anyone familiar with elephants will recognize it and it does tend to send a chill down your spine when you smell it at close quarters. Meeting a large aggressive male in full *musth* in a dense forest is not my idea of fun. *Musth* periods may now last from three to six months and may even take place twice in one year. The longest period in *musth* I have recorded is over five-and-a-half months in the case of a very large single-tusked 45-year-old male.

Such animals are the ones responsible for most successful matings and it is not surprising that they come into *musth* when they are in peak body condition. Dominance in elephants is basically a function of body size and condition. *Musth* does bring about a

An elephant sprays his back with dust to keep away parasites and to counter the heat. Elephants will also cake their bodies with wet mud at water holes. The wrinkles in their skin help to retain the moisture and thus keep their bodies cooler for longer periods.



The author is seen tracking a collared elephant in the wild. Radio-tracking has enhanced the accuracy of information collected from the field and thus helped land managers make better decisions.

change in the established dominance setup but things revert to normal once *musth* is over.

As we have seen *musth* is very energy expensive for the male. He must reduce his feeding, yet increase the amount of energy expended to roam over extensive areas to locate clans and oestrous females. It stands to reason therefore that a greater body size would result in the male being able to withstand greater energy loss during *musth*... for longer periods. Since the largest males are able to sustain *musth* for the longest periods they are the ones that enjoy the greatest breeding success.

"The longest period of* musth *that I recorded was five-and-a-half months."

As the male dribbles urine continuously it loses a lot of water. Since the urine acts as a scent signal, males in full *musth* generally avoid entering water and bathing as the scent would be washed away. Loss of water and decreased heat loss (no bathing) also inflicts stress on the body. Males that go through long periods of *musth* can lose over ten per cent of their body weight. Larger males with greater body reserves are able to sustain *musth* for longer periods than younger and smaller males. After *musth* the weakened males retreat to feeding sites and concentrate on feeding and recovering their body condition for the next period of *musth*.

Musth males don't just wander around at random hoping to find oestrous females. Just as females have intimate knowledge of their home ranges, males also know when and where different clans operate in their home range. As clans show strong fidelity to their home ranges and the seasonal ranges within it, males know exactly where to find the female clans. During *musth*, males search purposefully for oestrous females within the home ranges of known clans. It is known that the temporal gland secretion

(fluid) and the dribbling urine function as an olfactory signal. Researchers had suggested that this was a male to male signal, where a bull in *musth* would signal to others about its condition and warn them. This signal was supposed to keep other males away from the *musth* male and thereby eliminate the possibility of conflict. But my observations showed that non-*musth* males continue to move about within the *musth* male's area and competition for females continues. I feel that it is essentially a male-to-female signal indicating the condition of the male and perhaps inducing oestrous. Such a strategy would have the advantage of reducing the chances of the male and female being unable to come together during the very short oestrous period. If females synchronised their oestrous with that of the *musth* males in the locality, their chances of mating are enhanced. Its secondary function could admittedly be to announce its condition to other males.

"Females synchronised their oestrous with that of musth males."

Females come into oestrous once in four months and are receptive only for a few days. Researchers used to wonder how males were able to locate oestrous females within such a short period. This could be explained by the above ability. The extensive ranging habit of males also brings them in repeated contact with females. And, in Africa, studies have shown that females in oestrous vocalize using low frequency infrasound, which carries for long distances. Males locate the females using these calls.

On locating an oestrous female, a male will mate and then remain with her through her entire oestrous period, guarding her from other males. On mating, the female vocalizes and the entire herd may rush to her and join in the vocalizing. Most of this is in infrasound which is not audible to the human ear. As infrasound

travels far all males in the area are attracted to the mating pair. This brings about competition for the female with success going to the dominant male. There are some instances when multiple matings by different males have been recorded but these are rare. Females would normally reject younger males, but now with poachers having picked off the largest tuskers, younger males will be allowed to approach them.

The elephant has a long gestation period, between 20-22 months. The natural bulk of the female disguises the pregnancy that may go undetected by all but experts. At the end of the long gestation a calf, 90-105 cm. tall and between 95-135 kgs. is born. If the herd is around when the female calves, the new one will arrive to the accompaniment of excited trumpeting. Some subadults and juvenile females (usually older daughters) will stay close at hand to fuss over the calf. The mother and others will assist the calf onto its feet initially, but soon the little one will struggle to its own feet, albeit in a wobbly and unsure manner. When a calf loses its balance and falls, the mother and allomothers are all aflutter. But in ranging animals like elephants, newborns quickly 'get on the road'. I once observed a one-day-old calf walking several kilometres. Every one of the calvings I have watched have been different in some way or other and I have always come away having learned something new about elephant behaviour.

"Females normally reject young males, but poachers have picked off the largest tuskers."

Calves grow quickly and can weigh nearly a ton by the time they are five or six years old. They will continue to grow throughout till they attain a really old age. They are, in fact, considerably like humans in their life cycle. Their life span is 60 to 70 years, though

in captivity this may be longer. A female may deliver 10 to 12 calves in her lifetime. She could start calving at 18 to 20 years and be a great-grandmother before she dies. The time interval between two calves is four to five years, depending on the quality of habitat and other stress factors. When conditions are not perfect the gap between one offspring and the next may be prolonged. When you consider the nearly two-year gestation period and then the long period when the calf must be suckled... till the next one arrives, females seem to be either pregnant or lactating throughout their adult life.

Clans have well defined home ranges within which all clan members can be seen to operate in a fairly coordinated manner. Home ranges vary in size and cover areas large enough to provide adequate resources for the clan. Of course, the habitat quality varies over different seasons and also between different areas within the home range. Elephants must therefore undertake long and often arduous migrations between different parts of their home range to obtain the best resources. Competition between clans in overlapping ranges also affects migration.

"In Africa elephants are found in true desert conditions in Namibia."

Ecological adaptations

Elephants show great adaptability and are found amongst almost all types of vegetation. In Africa they are even found in true desert conditions (areas with less than 200mm annual rainfall), in Namibia. In India, elephants though not found in true deserts, range from thorn forests in arid areas with an annual rainfall of 600mm, to evergreen forests with rainfall over 4,000mm annually. They have, of course, successfully adapted to life in all the different vegetation types.

A large body size means that prodigious quantities of food must be eaten to ensure both growth and sustenance. Under such circumstances it is difficult for an animal to be a selective feeder. The time and energy spent on finding and feeding on specific food would be too high and would limit the species only to very specific habitats rich in those particular foods. Elephants have therefore evolved to become generalist feeders. They will eat grasses, herbs, shrubs and even small trees. This is one key factor in their successful colonisation of the varied habitats they now occupy. Additionally, as we have seen, a large body size delivers them a greater ability to withstand stress and reserves to tide over lean periods.

"In India elephants do not inhabit true deserts, but they do use arid zones."

Their long lives and social organization allow elephants to develop an intimate knowledge of their home ranges by learning from older matriarchs. Thus, in years when the conditions are the poorest due to adverse climate, they are able to locate specific areas within their home range that harbour vital resources to tide them over. Such intimate knowledge of the home range and the resource distribution therein under varying climatic cycles is rarely available to most other herbivores that share the elephants' habitat.

In the 80's, the drought in the Namib Desert in southern Africa resulted in high mortality for most resident species. But no elephants died. This ability to hone in on emergency resources is clearly passed down through clans from generation to generation. The surviving sub-adult females in the clans are now armed with the same information and will use it when they become matriarchs and must lead their herd through similar drought conditions at some future date.

With so many advantages to be gained, it is little wonder that clans show very strong fidelity to their home ranges and migration routes. They also show strong fidelity to their seasonal feeding ranges and return to these spots year after year. I should mention here that behavioural (social) constraints based on established clan hierarchies within populations are often more important in deciding which clan operates where, rather than habitat variables alone. It is because of this behaviour that we find that some clans continue to operate in secondary or marginal habitats even in adverse conditions.

"In the drought of the eighties in the Nabib, no elephants died."

The daily routine of an elephant is fairly straightforward. It will spend almost two thirds of its time feeding. This is why, if you get to see an elephant in the wild, the chances are you will see it eating something! It is estimated that elephants consume between 135 to 200 kgs. of fresh fodder every single day. The dry weight equivalent amounts to a consumption of around one-and-a-half to two per cent of their body weight each day.

The grass eater's burden

It's a tough life, being a herbivore. Food quality (nutrients and palatability) varies with seasons and components of the plant material such as cellulose are difficult to digest. They are therefore fermented or broken down by bacterial action within the digestive system of the elephant. Some plants also contain chemicals that hinder easy digestion. In both the cases the animal must retain the ingested food long enough to overcome the problem. Elephants simply do not have the time to allow for an extended digestive process. Their energy requirements are such that if they retained small amounts of food for lengthy periods of time they

would be forced to restrict themselves to only the best resource spots. Here a number of other herbivores would compete with them for the same resources. By opting for a generalist feeding strategy, coupled with bulk feeding and a low retention time for food in the digestive tract, they have struck upon the ideal survival strategy. The fact that they sacrifice quality for quantity works to their advantage. Naturally, they will eat the best whenever they can get it. But they will not go specifically searching and feeding only on such high value nutrition. Interestingly, this strategy not only provides them with greater access to greater varieties, but also reduces the amount of time they must spend searching for food. In the process, they lose out on digestive efficiency. Elephant absorb only 50 per cent or less of the nutrients from the food they consume. Hence the long hours spent on bulk feeding.

"Elephants sacrifice quality for quantity of food... and this works to their advantage."

If available, elephants will gladly feed on grass which forms a major portion of their diet, but will supplement this by browsing on woody plants. They feed entirely on grass during the wet season when the fodder is soft. Later, as the grass begins to dry and becomes coarse, they pull out the entire clump of grass and eat only the softer basal portion, discarding the dry and coarse sections. Soil adhering to the roots is removed by striking the grass against their feet. Elephants are among the few animals that make a concerted effort to clean their food before eating it.

The bark of trees and woody plants form the main part of their browse diet. Leaves of only very few plants are eaten. In most trees, leaves are the targets of herbivores. Plants develop various chemical compounds that are toxic or inhibit digestion as a means

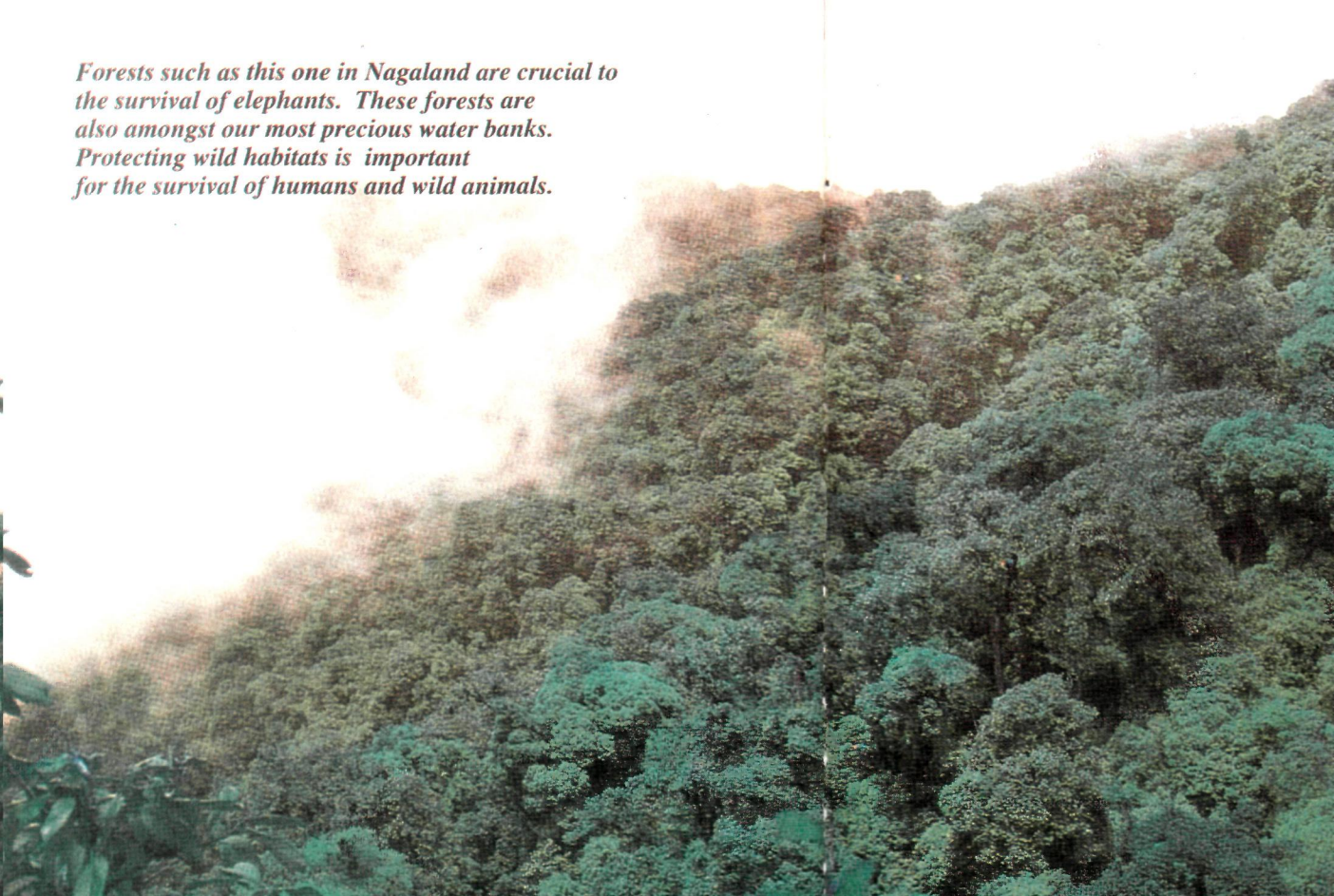
of protection from herbivores. It is possible that because leaves are so targeted they have more of these defensive compounds than the rest of the plant. As the elephant has a poor digestive system it probably avoids leaves from plants which have defensive compounds. Bark would not be as well guarded and also contains a lot of nutrients. But, it could also be that in the dry season when elephants really turn to bark, most trees in the deciduous forest have shed their leaves and bark is the only thing available to elephants. Their selection of grass parts and tree bark shows that even within a rather broad unspecialized diet, elephants will still try to optimise their diet by being as selective as possible.

"Some elephants snore in their sleep, especially older bulls."

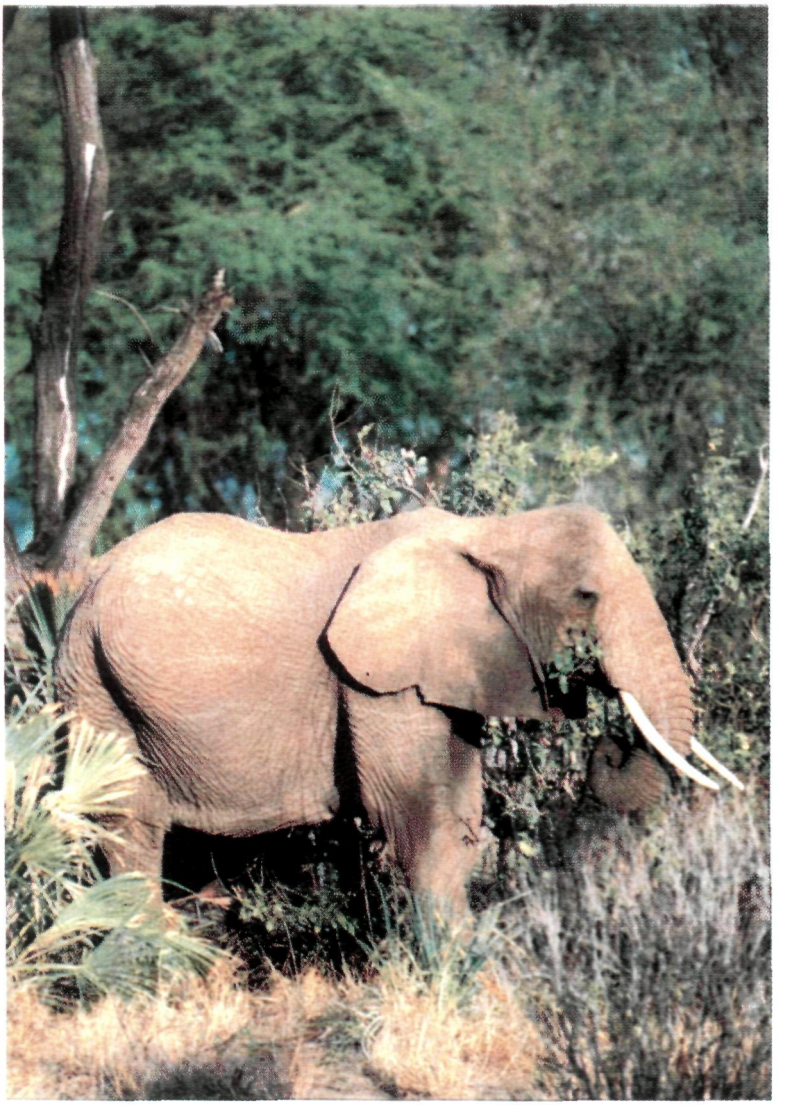
Elephants feed for most of the day and break for rest during the hottest part of the day. They can actually sleep standing, but it is common to see some or the entire herd lying down and sleeping. Calves almost always lie down to sleep. Elephants also sleep briefly early in the morning getting up and moving before daybreak. Even for someone used to seeing elephants over extended periods of time, seeing a herd sleeping is a fascinating sight. All the noise of their feeding and movement comes to a halt and a strange silence descends on the forest, broken occasionally by the sound of... snoring. Yes! Its true. Some elephants do snore when they sleep, especially older bulls!

Water plays a major role in the daily life of the elephant. They consume around 100 to 200 litres of water daily. Water is also used to cool the body. Elephants do not have sweat glands and cannot cool their bodies as we do. But they have their ways! The elephant's ears are large and infused with a rich network of blood vessels close to the surface. As the elephant fans its ears the hot

Elephants look after their young (above) with great dedication. They are not able, however, to teach them how to deal with errant human behaviour. Removal of wild elephants for zoos (top) depletes and distresses already traumatised herds.



Forests such as this one in Nagaland are crucial to the survival of elephants. These forests are also amongst our most precious water banks. Protecting wild habitats is important for the survival of humans and wild animals.



The African elephant, Loxodonta africana, *is being hunted to extinction for the value of its tusks. The ivory trade spills over into India to render the Indian elephant,* Elephas maximus, *equally vulnerable.*

blood from the arteries gets cooled and returns to the body. Quite literally, the ear acts as a radiator. It has been found that in the African elephant this mechanism can cool the blood by as much as 19 degrees centigrade! When the mercury really rises elephants will extract saliva from their mouth using their trunk and spray it behind their ears and on their necks, this increases the cooling process when the saliva evaporates.

If undisturbed, elephants will almost certainly head towards a river or water hole after feeding. They will gladly spend considerable amounts of time in the water especially in the summer, splashing their entire bodies to cool themselves. They also have mud baths. Both water and mud are retained on the elephant skin for much longer because of the wrinkles and this helps by extending the cooling process even after they leave their pools. They will, of course, seek and find cool shady places to rest up during the heat of the day. This is yet another reason that dense-crowned forests are so crucial to their existence.

"When elephants fan their ears these act like radiators to cool their bodies."

No threat but man

Adult elephants do not have any natural enemies. In fact there are very few records of calves or juveniles being killed by tigers. The few instances of adults having been killed by tigers are the exceptions rather than the rule. *Homo sapiens* is the elephant's only enemy.

Most natural deaths of elephants occur when they can no longer eat or digest their food. Elephants have six sets of molars, which are used in a sequence. They descend from the jaw with a forward flow, where one set is gradually pushed forward as it wears off,

by the set preceding it. Only one full set or two partial sets are in wear at any given time. As the molar gradually wears off and becomes small it keeps getting pushed forward until it falls off. When the last set, which is in use at 60 years of age wears off, the elephant can no longer grind and digest its food. Elephants, with their poor digestive systems, die of starvation after their last molars have been lost. In Africa rare cases of elephants having a seventh set of molars have been recorded.

We are responsible for most elephant deaths, directly or indirectly. Poaching in Asia has not been on as large a scale as that in Africa. But even the present level of poaching is harmful because it is primarily targeted at males for their tusks. This has led to skewed sex ratios in the population and loss of most big males with tusks. Apart from the serious genetic loss, we too suffer the aesthetic and cultural loss of the vanished tuskers. *Makhnas* will continue to be safe from poachers and they are no doubt equally beautiful animals, but the loss of a trait (tusks) is bad for the population. Poaching is severe in South India where most of the males have tusks. Most of the large tuskers that I knew at the beginning of my study in the Nilgiri Biosphere Reserve are no longer around. They have all been poached. Very little information has been gathered on poaching from other areas. But we know it exists.

"Adult elephants have no natural enemies apart from Homo sapiens."

People have often wondered how elephants continue to breed successfully even in areas with severe poaching, where the ratio between adult males to females is extremely skewed. If we take into account two facts about the elephants' reproductive behaviour, the reason for their successful breeding becomes clear. First, females have an intercalving interval of four to five years. This

means that only 20 per cent to 25 per cent of the females are receptive in any given year. So a ratio of one male to four or five females in the population is in effect an operational ration of one to one (since only one in four or five females will be receptive in any year).

The second point is that males are polygamous, so one male mates with several females. This means that the sex ratio can drop even further without affecting the fertility of the population. But loss of males should be viewed as loss of genetic variability of the population as very few males will then do all the breeding. Often people assume that a population is healthy when they see a large number of calves in the population. But this is a dangerously faulty way of looking at the health of the population, as fertility is likely to drop only when male numbers are extremely low. At this point it just may be too late to save them.

"Loss of tuskers to poachers amount to a loss of genetic variability."

In some parts of Northeast India and parts of Asia elephant meat is eaten and females are also poached. Any way you look at it, poaching remains a key threat to elephants. Elephants are also killed when they raid crops. With increasing exploitation of elephant habitats by the growing human population, for agriculture and housing for instance, elephants come into greater conflict with humans. This is detrimental to both, but it is the elephants that ultimately lose out in such conflicts.

Fragmentation of habitat and loss of traditional corridors (routes) between different habitats are another leading cause of man-animal conflict. Herds have even begun to leave their traditional ranges and wander outside through human-use areas, leading to heavy loss of human life and property. This is because the old

ranges are so degraded and fragmented that they can no longer support them. Outside the forest elephants embark on a futile search for non-existent food sources and they wind up raiding crops. This has been happening in South and Central India and has led to severe problems. In some cases the only solution is to capture these elephants as they really have nowhere to go. Moving them to any other area will only result in relocating the problem. Habitat loss, fragmentation and degradation are the main threats to the survival of the Asian elephant.

Elephants are now restricted to habitat islands surrounded by human habitation and they have nowhere to go. Swelling elephant populations in good areas face the problem of local over-abundance. They are now forced to accelerate the destruction of their own habitat and ultimately come into conflict with local communities. This problem of local 'over-abundance' will have to be dealt with as it is going to be a major problem in the future.

"If people enter elephant forests they must accept the risk of being killed."

Man has also suffered at the hands of elephants. What really catches the attention of most people and of scientists is the issue of manslaughter by elephants. Though this problem has been studied by many, I feel that such studies are futile. So long as people enter forests, for whatever reason, they must accept the risk of being killed. Similarly, when elephants come into agricultural areas, people are likely to get killed. The solution obviously lies in keeping man and elephant apart... a tall order at best in space-hungry Asia.

Crop raiding has increased almost everywhere because of the reasons already mentioned. This is a complex problem and requires the management of elephant habitats, their population

and also use of crop protection methods. As long as the elephant habitats continue to be degraded and fragmented, elephants will break out to seek their required food and water from human habitats. My study on their raiding behaviour showed that elephants that had their home range intact or nearly so did not raid farms. In other words, raiding is a result of compulsion, not choice. Local over-abundance of elephants, which depletes resources, could also force some herds to the periphery where they are likely to raid crops.

"Elephants are restricted to habitat islands... they have no place to go."

Crop protection methods depend on the owner's capacity and commitment to protect his crops. Unfortunately, poor farmers often do not have the resources to protect their crops. The only defence they have is to build thorn fences and stay guard all night, hoping they can drive away the elephants by shouting, beating drums or sometimes using fire crackers. The better-guarded fields have trip lines that trigger firecrackers so that the farmers are alerted of the elephants' arrival.

The forest departments usually try trenching along the forest boundaries but these have limited success, as they are not maintained properly and soon stop functioning as barriers. Electric fences that pass high voltage but extremely short duration pulses through the wire are effective barriers for they only shock the animal without harming it. However, these fences need regular maintenance and are quite useless if these are not in top working order. Electric barriers are cheaper than trenching and are being used successfully by many of the larger farmers. One way or the other, conflicts will continue so long as we fail to protect and manage elephant habitats and populations. Saving the el-

ephant is going to take a lot of effort and the question likely to be asked is: "Why save elephants at all?" Apart from all the ecological reasons, I believe we have a moral duty to an animal that has served man for over 4,000 years. It has served kings and beggars with equal dignity. It has stood with us in our holiest temples and in our bloodiest battles, from entertaining the tiniest tots to executing hardened criminals it has done all we have asked of it. We have joked about it and yet worshipped it; it has brought love and joy to the lives of some, pain and terror to others.

No other living creature has been quite as involved with man as the elephant. Ironically, it has even helped us to destroy its habitat by being the main source of transport and power in the timber industry. And then, it has also helped us capture and train other elephants. We definitely owe the elephant something in return for over 4,000 years of service. Our efforts at saving the elephant will also yield benefits to us. Elephants require large areas to survive naturally and by setting aside these areas for elephants we will be saving what little we have of our natural heritage. Most elephant habitats are crucial watershed areas of major rivers and these are vital to our own food security and survival. Elephants perhaps have the largest home ranges of all the animals in Asia. Setting aside adequate area for them will automatically ensure that the ranges of most if not all other species that co-exist with them will be saved. Put simply: by protecting the elephant we protect the entire gamut of biodiversity contained in its forest home.

"Saving elephants takes a lot of effort. Some ask why we should save them at all?"

A decade with elephants has diminished nothing of my fascination for them. I know that this fascination is shared by millions of others, including you, the reader. There will always be some part

of us that will respond to the elephant's varied nature and behaviour and its ancient association with man. It would an unparalleled tragedy if this long association is allowed to be broken. India and Asia without the elephant will be culturally and morally insolvent. The Kingdom of Siam went to war over the possession of white elephants. Today we need to wage a war to protect the entire species. This war entails curbs on our own insatiable greed for more and more resources and an alteration of attitudes which display scant regard for other creatures that share this planet with us.

To set aside tiny fragments of this vast land; to rein in our greed a little. Is this asking for too much? Especially when this could save both the elephant... and us too?

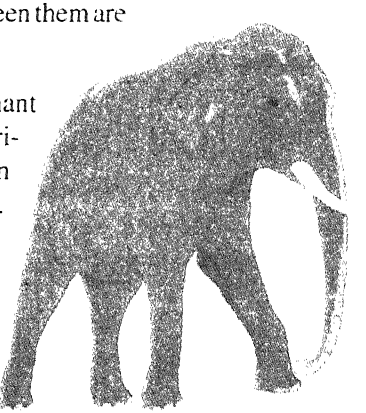
Annexure 1

Differences between African and Asian elephants

There are only two living species of elephant belonging to two genera. The African elephant *Loxodonta africana*, (facing page) and the Asian elephant *Elephas maximus* seen below.

The African species has two distinct subspecies. The bush elephant *L. africana africana* that lives in the Savannas, is the one with which most people are acquainted. The other subspecies is the forest elephant *L. africana cyclotis*, which lives in the dense forests of central and west Africa. It is much smaller than the bush elephant. It has smaller ears and its tusks are smaller, thinner, straight and pointed downwards, making it easier for the elephant to move in forests.

There are at least three subspecies of the Asian elephant though some authors have claimed more. In Sri Lanka we find *E. maximus maximus*, in India and continental Asia, *E. maximus indica* and on the island of Sumatra we have *E. maximus sumatransis*. Differences between them are negligible.



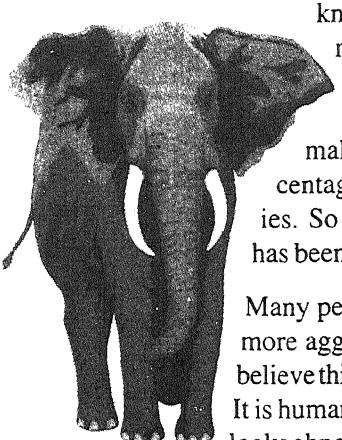
The African and Asian elephant differ in several ways. The African is at least 40 cm. taller on an average than the Asian elephant. In the African bush elephant, females are 2.7m to 3m. tall at shoulder and large males can reach 4m. In the case of the Asian elephant, females average between 2.3 to 2.6m.,

rarely reaching 2.7m., at shoulder. Large adult males average 2.9m. to 3.2m. at shoulder and rarely reaching 3.5m.

Though most experts claim that the African is heavier, I feel that the female Asian elephants are as heavy or heavier than their African counterparts. Female Asian elephants can weigh between 3 and 4 tons, while males will weigh between 4.5 to 6 tons.

The African elephant has larger ears than its Asian counterpart and the ear or 'dome' has an uncanny resemblance to the shape of the African continent! The head in the African elephant has a single hump while on the Asian elephant there are two domes. The trunk tip of the African elephant has two small projections while in the Asian elephant there is only one. These projections act like fingers and are used to grasp small objects. The African elephant is sway-backed while the Asian elephant has a hump on its back.

In the African elephant both the sexes have tusks while in the Asian species only males have tusks. Some African elephants and male Asian elephants do not have tusks. Tusk-less males in India are known as *makhnas*. It is interesting to note that in Sri Lanka less than 10 per cent of the males are tuskers while in south India over 90 per cent of the males are tuskers. Elsewhere the percentage of *makhnas* in the population varies. So far, no explanation for this variation has been volunteered.



Many people have claimed that *Makhna* are more aggressive and dangerous, but I do not believe this is true, they behave just like tuskers. It is human nature to believe that anything that looks abnormal will behave abnormally.

Annexure 2

Population estimates and distribution of the Asian Elephant

Through most of Asia, including parts of India, there are no reliable figures available on the elephant populations. In many cases, where some information is available, it only indicates an approximate minimum number. In most cases it is just guess work and often credibility is given to this estimate by calling it an educated guess.

It was always believed that elephant populations in South India were the best censused. The area was suitable and, large scale and co-ordinated efforts were made by the three Southern States Karnataka, Tamil Nadu and Kerala. But the latest estimates have revised the numbers by + 25 per cent to over 50 per cent from previous estimates. This only goes to show how inaccurate the earlier estimates were, even in areas that were (supposedly) well censused.

The accuracy of estimates for other areas, where census was carried out less intensely, often using ill-defined or questionable techniques or just guess work is questionable.

It is important to remember that except in a few countries, especially where elephants are being exploited, there is no worry about low or declining elephant populations. The major threat is the loss of elephant habitat. There aren't any good, large, unfragmented and undisturbed habitats which can support genetically viable elephant populations.

Most elephant habitats are small isolated patches or larger fragmented areas. The few large areas that remain more or less intact have some human settlements within and are exposed to

biotic pressure from the surrounding human population. The major threat to the future of the Asian elephant is that of inadequate space. These magnificent creatures are fast running out of space to live in.

The figures given may not be reliable but they are the most accepted ones and are an indication of what the population is likely to be.

Country	Min.	Max.
India	16,745*	22,435 *
Myanmar	6,000	10,000
Thailand	2,925	4,550
Laos, Vietnam & Kampuchea	4,500	7,000
Sri Lanka	2,000	4,000
Malaysia	800	3,000
China	500	500
Borneo	500	2,000
Sumatra	2,800	8,800
Total	**38,770**	**58,285**

* There is a small population of 30 to 50 feral elephants on the Andaman Islands. The latest estimates put the Indian population at 25,000 elephants.

Annexure 3

Capture and training of elephants

Capturing and training of elephants for work could have originated by chance. Orphaned calves that strayed into agricultural areas were probably raised as pets. The possibility of training and using them for work would not have taken long to figure out, seeing how easily they were tamed.

Elephants are captured in several ways. The simplest is the pit method. A pit is dug along elephant paths in the forest and partially filled with grass and small branches to break the fall. It is concealed and when an elephant falls into it, Koonkie elephants are brought to assist in getting the trapped elephant out of the pit. This is done gradually by filling the pit. Koonkie elephants are large elephants that are trained in the capture and handling of wild elephants.

Another method that has all the trimmings of the wild West is the noosing method. Here experts ride captive elephants into a herd and separate the selected individual from the herd and noose it. An a even more daring method is to noose the legs from the ground without the captive elephants' help. This is an extremely dangerous way to capture elephants.

Kheda is a method where entire herds are captured. It is an elaborate method where a large stockade is built and elephants from the surrounding areas are driven into it. Koonkies are then used to capture and bring the elephants out from the stockade. Bigger and aggressive elephants are shot. This method is often very wasteful.

Variations of these main methods are used wherever elephants are captured. Today drug immobilising techniques are increasingly

used to capture elephants. A very potent drug, etorphine hydrochloride which is 10,000 times more potent than morphine is injected into the elephant from a distance using a dart gun. This drug immobilizes the elephant within 5 to 15 minutes. It has a tendency to raise body temperature so water is needed to cool the elephant after it is down. This drug is very suitable for elephants because its effects can be reversed very quickly using an antidote called Revivion.

Training varies and there are basically three methods. All three start with making the elephant familiar with human presence and getting it used to being fed and touched by human beings. It is here that things are left to chance. In the first method the elephant is tied in an extremely stretched position with little movement possible. It keeps straining at the retaining ropes. Later when it quietens down it is tied between two large koonkies and made to move on command, using brute force to teach it. Most elephants bear injuries from ropes.

In the other method sharp spears are used to control the elephant and instead of force, pain is used as a controlling medium. The elephant is prodded into obeying the commands. Variations of these and also a combination of these methods is used by almost all the trainers in Asia, the common factor being the use of force and pain. All the handlers use sharp objects (*ankush* or such objects) to control the elephants. These are very cruel training and handling methods and very barbaric too. It could appeal only to a cruel and sadistic mind. The elephant is assumed to be a cruel brute and treated as such.

The third method used only in parts of South India and polished to perfection by the Forest Department of Tamil Nadu is the Kraal method. This method assumes that the elephant is an intelligent and sensible animal and is treated as such. The Kraal is a small

enclosure made of huge logs and padded with bamboo. The captive elephant is brought to the kraal by koonkie elephants and put in. The captive elephant can move around but does not have enough space to charge or move fast. It cannot injure itself as the space won't allow it and the bamboo padding also helps. It is not restrained so it does not get injured by tuging or pulling at any restraining ropes.

It settles down very quickly and is fed by the future mahout. The elephant associates him with food and soon loses all fear of him and the others around. Training starts now. Unlike the other method where force and pain are used, this method uses the reward of a choice tit-bit (sugar-cane usually) to tempt the elephant to do things. A thin stick is used to guide the elephant. The *mahawat* will teach it commands like "turn left" by repeating the command and holding the sugar-cane reward to the left of the elephant while gently nudging the elephant on the other side so the it turns left. Elephants are very intelligent and they soon realise that by doing or by following the prodding action they get rewarded. They soon begin to obey all the commands that they are taught. It is possible to train even the biggest bull in this way.

I have seen the Tamil Nadu Forest Department mahouts (all are tribals) handle all musth elephants, including the largest with just their stick, many of them do not even know what an ankush looks like. This is the most humane way to train and manage elephants. It needs to be adopted by all elephant handlers. There is no justification for any of the cruel methods used throughout the rest of India and Asia.

Annexure 4

Radio-telemetry and elephants

Elephants range over large areas and trying to study their ranging behaviour using conventional means is difficult. Re-finding identified elephants, believe it or not, is like looking for a needles in a haystack. The forested areas of India are definitely not suited for such attempts. Take my word for it; I did exactly that for five years. Electronics have come to the rescue of many frustrated biologists like me. Today we have radio-telemetry, a research tool that has made data collection more reliable and precise. The insight we gain on the behaviour and ecology of the species is amazing and the management recommendations are also more precise.

Radio-telemetry involves fixing a radio transmitter (which sends out a silent radio signal) onto the study animal and then using a directional antenna and a receiver to locate it. The antenna looks somewhat like a TV antenna and when it is pointed in the exact direction where the animal is, the signal strength is strongest. A compass bearing is then taken to isolate the direction from which the strongest signal emanates. If you track signals from at least two different locations and draw lines on the map along the compass directions, the point of intersection will be the location of the animal. The method is called triangulation and is used when the study animal is too far or cannot be approached for visual sighting. Rather than depend on this indirect method it is generally better to follow the direction of the signal and locate the animal. The exact location of the animal is then known and more data can be collected on it.

Radio transmitters should not exceed five per cent of the body weight of the subject though there are exceptions where transmit-

ters up to eight per cent might be used. Transmitter weight is not a problem with large animals like the elephant where the actual collar weighing several kilograms is still only a fraction of the body weight. For small animals, transmitters weighing less than one gram have been developed for special uses. The life of the transmitter depends on the power source, as well as other factors such as the pulse rate of the signal and the weight of the entire package. The requirements are often conflicting — the greater the power output, the greater the range... but the shorter the battery life. Similarly, higher pulse rates translate into easier location, but more power consumption. In the case of elephants, radio collars are supposed to last up to three years. In my experience they have lasted over three and a half years and more.

Radio telemetry has been used successfully in India only in the 90's. Earlier most attempts were a failure or did not help in the collection of any significant or valid data. The Wildlife Institute of India (WII) tracked only one bull successfully in the Rajaji National Park. A Bombay Natural Hisotry Society study in the Nilgiri Biosphere Reserve revealed that clan home ranges were as large as 530 to 800 sq. kms. This was something no one had expected. Earlier studies underestimated the home ranges. The WII study was carried out successfully even though the transmitters gave trouble and signal strength was minimal. The single clan studied there had a home range of 34 sq. kms. In all probability this was a pocketed herd which did not really represent a natural range. But it just goes to show that we need much more studies in this field before we can really really claim to understand elephants.

Radio telemetry studies have also helped us to identify the crucial corridors that elephants use in their seasonal movements. Their strategy of habitat utilisation has also been better understood and

we are changing many ideas and assumptions about elephant behaviour and ecology.

There are those who say that radio telemetry is an expensive tool. True. But this is hardly a valid reason not to use it. As a nation we need to wake to the fact that without proper research tools we will waste much more money in opting for wrong methods which will produce unacceptable results. The BNHS study is a classic case, I studied elephant ranging for five years without radio telemetry. The project was costly from the point of time, money and the risks I undertook to collect the data. The results were acceptable but not what I really wanted, or what was needed. I highlighted this in the report. If at all my findings had some worth this was because I spent five years in the forests just to collect the data. But most research projects last for just two or three years and without telemetry such short-term projects are likely to reveal little if anything of substance on movements alone. As for ecology and behaviour... forget about it.

After I started using radio telemetry I was still exposed to risks and in fact the physical work was even harder and expensive to boot. But in just one year I collected more data than I was able to in five years. And this one-year's data was more accurate and useful than all the earlier five years old data put together.

Annexure 5

Project Elephant Reserves of India

1. South West Bengal North Bihar-Orissa Elephant Reserve

1. The Reserve comprises of moist deciduous and semi-evergreen forests in Orissa, Bihar and South West Bengal. The estimated elephant population of the area is around 3,000. The forest divisions and wildlife reserves covered by the reserve are:

Orissa-Bonai forest division part, Sambalpur forest division part, Devgarh forest division, Keonjhar Karanja, Simlipal, Angul forest division, Ushakoti wildlife sanctuary, Khalsuni wildlife sanctuary, Badampahar.

Bihar-Dalma wildlife sanctuary, Saranda forest division, Kolhan forest division, Porhat forest division, Dhalbhum forest division.

South-West Bengal-Mayur Jharna wildlife sanctuary.

The total area of the reserve is about 8,000 to 9,000 sq. kms.

2. The main problems of management are: large-scale mining, replacement of natural sal forest with teak forests and included cultivation by the Jharkhand activists. Construction of dams has also contributed in depleting elephant habitats. Large-scale disturbances in the elephant habitat have resulted in long distance migration towards Raigarh and Sarguja districts in Madhya Pradesh and Midnapur districts in West Bengal. The instances of man-elephant conflict have increased seriously during recent years due to chasing of elephants from one place to another by the farmers.

2. Kameng-Sonitpur Interstate Reserve

1. The area of the reserve extends over about 120 kms. long stretch of semi-evergreen forests in Arunachal Pradesh and Assam. The estimated of the reserve is about 7,500 sq. kms.

covering the following areas.

Arunachal Pradesh-Kheolong forest division Bandardeva forest division, Darang East and west forest division, part of North Kamrup forest division.

2. The main problem of management in the reserve is continued denudation forests for Bandardeva division in Arunachal Pradesh and all the areas in Assam. Settlements leading to fragmentation of elephant habitat in Bandardeva forest division has also affected the elephant habitat in the reserve. The situation has been further deteriorated due to growing insurgency. The action will have to be taken on priority basis to stop the degradation of forests and programmes for eco-restoration and establishing crucial elephant corridors will also have to be taken up.

3. Dibru Deomali Interstate Elephant Reserve

1. This elephant reserve extends over an area of 5,000 sq. kms. covering following areas:

Arunachal Pradesh-Kamlong wildlife sanctuary, Turung reserve forest, Mamobhom reserve forest, Devmali Kanubari area (Khonsa forest division). Namsai forest division.

Assam-Dibru-Saikhowa wildlife sanctuary, Digboi forest division, Dumduma forest division and Jaypore range of Dibrugarh forest division.

2. The estimated elephant population of the reserve is about 1,800. Poaching by local people, including capture of live animals poses a serious threat to elephant population in the reserve. Fragmentation of the habitat and growing tendency of encroachments has affected the reserve over the years. Degradation of the habitat by overuse is also serious problem.

4. Kaziranga-Karbelong-Intanki Elephant Reserve

1. The elephant reserve extends over an area of 4,500 sq. kms.

and the estimated elephant population is between 1500 to 2000 elephants. The areas covered under the reserve are:

Assam-Kaziranga National Park, Karbelong East and Karbelong West Division, North Cacharhills Division (South upto Mufa), Golaghat division.

Nagaland-Intanki Wildlife Sanctuary.

2. The problems threatening the elephant reserve are insurgency, illegal extraction of timber, encroachment and poaching. The large scale dependence in the habitat have led to elephant straying out in agricultural fields and depredating agricultural crops.

3. The proposed action plan includes restoration of four migratory corridors between Kaziranga National Park and Karbelong forests. Effective control on poaching and wood-cutting should be implemented. Enlarging the Kaziranga National Park and creation of Mikhir Wildlife Sanctuary should be taken up on priority basis to provide further protection to elephants and facilitate seasonal migration of elephants.

5. Barail-Saifung-Interstate Elephant Reserve

1. Although the elephant population in this reserve is not more than 150, the State Government of Assam and Meghalaya are interested to create this elephant reserve mainly to provide protection to rich bio-diversity found in this area. The total area of the reserve is about 1500 sq. kms.

The areas included in the reserve are:

Assam-Cachar and Karimgang (part) forest division, North Cachar forest division part.

Meghalaya-Saifung reserve forest and Norphu reserve forest including the proposed link connecting the two areas.

2. At present almost no forest protection infrastructure exists.

3. The main problems, therefore, are protection of the habitat, and

control of insurgency. Shifting cultivation also affects the habitat at places.

6. Balphakram National Park and the Adjoining Areas

1. Balphakram National Park and adjoining areas are the only elephant habitat in Meghalaya, which can provide effective protection and long term safety to the elephant population. Areas covered by the reserve are Balphakram National Park, Dambu Sangsak-Darugia Rongangiri reserve forests including the proposed extension of the park, Bagmara and Cego wildlife sanctuaries and Rewak reserve forest.

2. The estimated area of the reserve is about 8,000 sq.kms. Out of this, about 55 per cent is under vegetation and only 7 per cent are under primary forest. The estimated elephant population is about 2,500.

3. The main management problems are insurgency, poaching from Bangladesh side, shifting cultivation and cultivation of cash crops by the shifting cultivators. The proposed action plan includes extension of Balphakram area to about 1,500 sq. kms., protection from Bangladeshi migrants, capture of excess elephants and activities for ecodevelopment and ecorestoration. Expeditious payment for crop damage and human deaths is also very essential.

7. Nilgiris and Eastern Ghats

1. This is probably the largest reserve for elephants in terms of population size and covers an area of 11,000 sq. kms. spread over the states of Karnataka, Tamil Nadu, Kerala and Andhra Pradesh. An estimated 5,000 elephants occur in this reserve. The forest divisions included in the reserve are:

Karnataka-Hunsur, Nagarhole National Park, Mysore, Bandipur Tiger Reserve, Chamarajanagar, Kollegal, Madhya (part) Bangalore (area = about 5,000 sq. kms.)

Tamil Nadu-Madumalai Sanctuary, Gudalur (part) Nilgiris North, Satyamangalam, Erode, Dharmapuri, Hosur (area = c. 5,000 sq. kms.)

Kerala-Wyanad Sanctuary and adjoining areas such as Alattur Reserve forest, Tirunelli, Judrakote, Hilldale, Trisshaleri, Harikara Shola, (area = about 1000 sq. kms.) and Chittoor District (A.P.)

2. The vegetation over this reserve ranges from moist deciduous forest through dry deciduous forest to dry thorn forest. There are also plantations mainly of teak and eucalyptus in many divisions. There are also numerous human settlements in most of the divisions excepting for Nagarhole and Bandipur.

3. The major conservation problems include habitat degradation and fragmentation due to human settlements in places such as Hosur, Dharmapuri, Erode, Satyamangalam, Nilgiris North, Wyanad, Bangalore and Kollegal. Elephant-human conflict in the form of crop depredation and human killing is also common in these areas. Poaching of tuskers was a serious problem in the past but has reduced in recent years.

4. Strategies for conservation should include: a.) Habitat improvement through fire conservation and plantation of suitable species. b.) Securing critical migration corridors such as Masinagudi-Singara corridor in Mudumalai, and Wyanad-Brahmagiri corridor in Kerala. c.) Trenching and/or electric fencing. d.) Compensation for crop damage and human deaths. e.) Ecodevelopment in areas outside wildlife protected areas. f.) Strengthening anti-poaching infrastructure.

8. Nilambur – Silent Valley – Coimbatore

1. This reserve lying mainly to the south of the Nilgiris and north of the Palghat gap is estimated to have a population of 500-600 elephants spread over 2,500 sq. kms. in the states of Kerala and

Tamil Nadu. The forest divisions include:

Kerala – Nilambur (including New Amarambalam, Karimpuzha and Nilambur Vested Forest), Palghat and Kozhikode (including Silent Valley National Park, Attapadi Reserve Forest, Muthukulam, Kallady upto Walayar, ex-Manjeri Kovilakam, Nedunjechi (area about 17,000 sq. kms.)

Tamil Nadu – Nilgiri South (part including Mukurthi Sanctuary), Coimbatore (area = 800 sq. kms).

2. The vegetation includes large stretches of evergreen forests in Nilambur, New Amarambalam, Silent Valley and Attapadi, montane shola-grasslands in Nilgiri South and evergreen and deciduous forests in Coimbatore. Plantation forests are seen in areas such as Nilambur, Attapadi plateau and Coimbatore has numerous human settlements.

3. Conservation problems include encroachments of evergreen forests, degradation of vegetation due to fire and human settlements and habitat fragmentation (in Attapadi).

4. Conservation strategies include: a) Protection of evergreen forests from degradation by fire control, safeguarding from over exploitation and moratorium on monoculture plantations. b) Eco-restoration through fodder plantations in Attapadi and parts of Coimbatore. c) Mitigating elephant-human conflict. d.) Securing of corridors in the Attapadi-Coimbatore region.

9. Annamalai – Parambikulam

1. This reserve to the south of the Palghat gap in the states of Tamil Nadu and Kerala. The total population of elephants is estimated at 1,000-1,200 spread over an area of about 3,000 sq. kms. The forest divisions include: Kerala – Parambikulam Sanctuary, Chimmony Sanctuary, Nenmara, Munnar (part), Malayatoor (part), Chalkudy (part) (area about 2,100 sq. kms.)

Tamil Nadu-Anamalais (including Indira Gandhi National Park) (area = 900 sq. kms.)

2. The vegetation is diverse and goes from wet evergreen forest to montane shola-grasslands, moist and dry deciduous forest, and thorn forests. There are extensive teak plantations in Parambikulam. Numerous dams and canals of the Parambikulam – Aliyar project are seen. There are also coffee estates at the higher altitudes in the Munnar-Valparai region.

3. Conservation problems include habitat fragmentation by the network of reservoirs and canals (elephants have fallen several times into these canals), degradation of moist forests due to fire and poaching of tuskers.

4. Conservation strategies include: a) Securing safe corridors for the migration of elephants. b.) Habitat improvement through fire control and plantation of suitable species. c.) Strengthening of anti-poaching infrastructure.

10. Periyar Madurai

1. This reserve is spread over an area of about 3,000 sq. kms. in the states of Kerala and Tamil Nadu. The estimated population of elephants is about 1,600-2,000. The forest divisions include: Kerala-Periyar, Tiger Reserve, Idukki Wildlife Sanctuary, Chinnar Sanctuary, Ranni (part), Kottayam (part), Konni (part), Achenkoil (part) and adjoining areas (area about 2,000 sq. kms.)

Tamil Nadu – Madurai South (including Srivilliputhur) (area = about 1,000 sq. kms.)

2. The vegetation includes evergreen forest, moist deciduous forest and dry deciduous forest. The Periyar reservoir is the focus of the elephant population here. There are numerous human settlements and plantations of the Kerala side.

3. Conservation problems include fragmentation of habitat,

elephant-human conflict, poaching of tuskers and illegal cultivation of "ganja" inside the forest.

4. Conservation strategies include: a) Identification and securing of crucial corridors for elephant movement throughout the reserve. b) Strengthening of anti-poaching infrastructure. c.) Eviction of illegal cultivators. d.) Mitigating elephant-human conflict. e.) Ecodevelopment programme for improving quality of life for people.

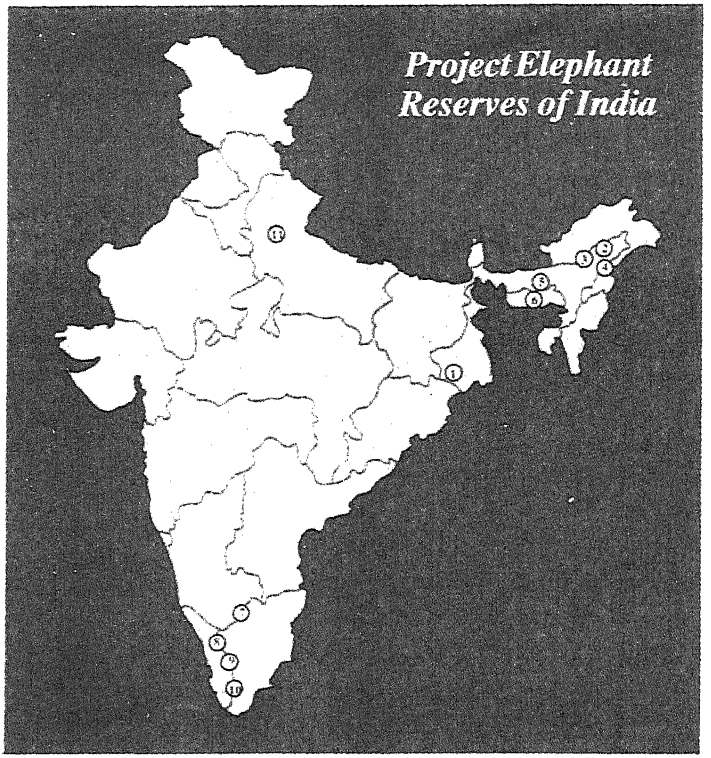
11. Rajaji – Corbett Elephant Reserve

The area which supports permanent populations of elephants in Uttar Pradesh extends through Shiwaliks and Terai Bhabar forest track along the foothills of Himalayas, from river Yamuna in the West to river in the East. The total area of the reserve is about 8,000 sq. kms. and the elephant population is estimated to be between 750 to 1,000.

The areas included in the reserve are – Dehradun forest division, Shiwalik forest division, Rajaji National Park, Bijnor plantation division, Lansdowne forest division, Kalagarh forest division, Ramnagar forest division, Corbett National Park and Haldwani forest division. The track is covered with sal forest, mixed with miscellaneous species and strewn with rivers and streams, which make it a suitable elephant habitat.

The main management problems are – diversion of land for non-forestry purposes, leading to disruption of migration corridors, over-grazing and lopping of trees by the live-stock held by local people and gujars. Large-scale monoculture plantations, construction of reservoirs has reduced the extent of habitat.

Action Plan – Restoration of migration corridors, control of grazing, eco-restoration programme and relocation of the population inside crucial elephant habitat, payment of compensation to local people for crop damage.



1. *South-West Bengal – North Bihar – Orissa*
2. *Kameng – Sonitpur Interstate (Arunachal/Assam)*
3. *Dibru-Deomali Interstate (Arunachal/Assam)*
4. *Kaziranga-Karbelong-Intanki (Assam/Nagaland)*
5. *Barial-Saifung – Interstate (Assam/Meghalaya)*
6. *Balphakram National Park & adjoining area (Meghalaya)*
7. *Nilgiris & Eastern Ghats (TN/Kerala/AP, Karnataka)*
8. *Nilambur – Silent Valley Coimbatore (TN/Kerala)*
9. *Annamalai-Parambikulam (TN/Kerala)*
10. *Periyar – Madurai (Kerala/TN)*
11. *Rajaji-Carbett (U.P.)*

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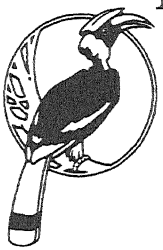

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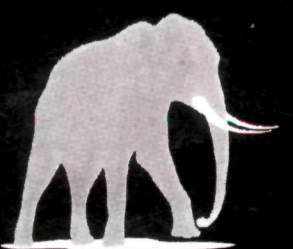

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